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MONTHLY REPORT TO THE NUCLEAR INDUSTRY

NO. 138

JANUARY 31, 1980

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PUBLIC AND GOVERNMENT POLICY

In the **US**, the final report of the Committee on Nuclear and Alternative Energy has been issued by the prestigious National Academy of Sciences. The most important conclusion of the report, entitled *Energy in Transition, 1985-2010*, was that the only economically feasible sources of energy for the US for several decades will be nuclear fission and coal. However, the authors expressed two major concerns about the long-term use of coal for electric power. First, coal will be required for the production of synthetic fuels. Second, the environmental problems caused by burning coal, particularly the long-term atmospheric effects of CO_2, would be a limiting factor in coal utilization. Thus, the authors concluded that nuclear fuel should be favored over coal for the production of electricity. The preparation of the report received the financial support of the US Department of Energy (USDOE), and it has been officially transmitted to the Secretary of Energy. It is not known what part the report will play in the formulation of energy policy in the US.

The **USSR** continues to move ahead aggressively with nuclear power development. Comecen is striving to achieve a nuclear power generating capability of 150,000 MWe, or 25% of total capability, by 1990. Nuclear power now accounts for approximately four percent of electricity produced within the Comecen bloc.

Nuclear power has recently made progress in other countries. Orders for two new 500 MWe nuclear plants in **Japan** were announced this month. In **Italy**, a government committee studying nuclear power has published its conclusion that the country can safely proceed with its plan to build twelve additional nuclear plants. In **Spain**, an aggressive program has been announced in which the equivalent of $4.5 billion will be invested in electricity generating facilities employing coal, nuclear and hydropower. The program, which included three new nuclear power units, is aimed at reducing the nation's dependence on imported petroleum from the current 75 percent to 50 percent.

Recent polls indicated that **Sweden's** referendum to be held on March 23, 1980, may show the population strongly in favor of nuclear power. Rather than a constraint, the results of the referendum may prove to be a public mandate to proceed with the nuclear power program. There will be three options presented to the voters:

—Continue operating the six existing units, and proceed with the other six which are either under construction or on order.

—Continue operating the six existing units, and proceed with the other six, but phase out all nuclear power when the operating life of these twelve units is over.

—Operate only the six existing units, but phase them out between 1985 and 1990.

The Swedish government is providing funds to three different committees, one for each option, for public promotion. It is estimated that the third option will cost the Swedish economy about 100 billion Swedish kroner (about $24 billion) plus adverse secondary effects. Although under no obligation to do so, the coalition government has stated that it will accept the outcome of the referendum as binding.

Nuclear power accounted for 22 percent of Sweden's total electric power generation in 1979. The average capacity factor achieved by its six operating units in 1979 was 64 percent, with the Barseback 2 unit achieving a high of 80 percent.

In the **Federal Republic of Germany**, the ruling Social Democratic Party has approved Chancellor Schmidt's energy program, which placed primary emphasis on the building of more coal-fired power plants, with secondary emphasis on nuclear power. However, it is not likely that the FRG can increase its domestic coal production, presently 90,000,000 tons per year, before the late 1980's, if at all. Therefore, it is expected that, after the elections scheduled for the fall of 1980, the government will again support nuclear power as the first priority in meeting the nation's growing electric power demand.

GENERAL

Conversion

There are indications that a secondary market for uranium conversion services (uranium concentrates to UF_6) may be developing in North America. Recently, a transaction was completed for the secondary sale of a large quantity of conversion services. The contract was styled as a swap wherein UF_6 was exchanged for an equivalent amount of concentrates, plus a cash payment to cover the conversion cost. The cash payment amounted to

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approximately $1.50 per pound U in UF_6 as compared to recent offers in the primary market well in excess of $2.00 per pound U. Since other uranium market participants have indicated a desire to sell some surplus conversion services, this type of transaction might well be repeated.

The recent conversion transaction took the form of a swap, under which the following took place:

1. The seller of the conversion services (seller) instructed its conversion contractor (converter) to make UF_6 deliveries as required by the buyer of the conversion services (buyer).
2. The buyer delivered an equivalent amount of concentrates to the seller's account at a location specified by the seller.
3. After completion of the swap, the seller invoiced the buyer for the agreed conversion price.

Future transactions may take the same form as described above. From the standpoint of the seller of the conversion services, the transaction is in effect a "deconversion" of UF_6 (i.e. UF_6 to uranium concentrates).

An alternative form of reselling conversion services would be by partial or complete assignment of the conversion contract. However, this method normally requires the agreement of the converter since most conversion contracts contain provisions which allow assignment only with the consent of the other party. Such consent is by no means automatic.

Also, conversion contracts normally provide that while the customer's uranium is physically located at the conversion facility, the customer will retain title to it. The latter provision is normally thought to mean that, *as between the customer and the converter*, the customer would retain title, and the converter would retain mere possession. However, this provision has, in a number of cases, hindered the sale, swap, loan or other transfer of the uranium by the customer while the material was located at the conversion plant. This has made it difficult to transfer uranium located at a conversion facility without the converter's consent. Therefore, it may be easier for a seller in the secondary market to utilize the deconversion alternative rather than an assignment.

The deconversion transaction may involve some other problems. For example, if the UF_6 is to be delivered to the buyer at a location other than that specified in the seller's conversion contract (usually an enrichment facility), the converter may be unwilling to warrant quantities and specifications at the time the material is later delivered for enrichment. Also, the converter may not wish to commit UF_6 cylinders to long-term storage. Another potential problem arises if the concentrates which the buyer intends to transfer to the seller are already in the possession of the same or another converter.

If a market for deconversion develops, it will probably have many of the characteristics of a spot market for commodities, such as uranium. In any event, it seems likely to develop apart from what has been considered the conventional market for conversion services.

Use of the deconversion transaction would help to increase the fungibility of the industry's uranium inventory, which is principally located at the conversion facilities. More extensive use of commercial uranium storage facilities would also help in this regard.

Optimum Tails Assay

Included in the US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract are provisions allowing the customer to specify, within limits, the transaction tails assay. This "variable tails assay" option, combined with the weakening price of natural uranium and the escalating price of separative work, has sparked new interest in the determination of an optimum tails assay. The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work and natural uranium feed. In fact, the optimum tails assay depends only on the *ratio* of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work (SWU). For a gaseous diffusion plant, there is an exact mathematical relationship:

$$\frac{C_f}{C_s} = (2X_f - 1)\log_e\left(\frac{X_f(1-X_o)}{X_o(1-X_f)}\right) + \frac{(X_f - X_o)(1-2X_o)}{X_o(1-X_o)}$$

Where C_f is the cost of feed, C_s is the cost of a SWU, X_f is feed enrichment as a fraction, i.e. 0.00711, and X_o is the optimum tails assay as a fraction. The above relationship is plotted in Figure A. To use Figure A, it is necessary only to calculate the ratio C_f/C_s and find the corresponding optimum tails assay from the curve.

For example, the current price of a SWU under fixed commitment contracts is $98.95. Using this

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month's Exchange Value of $40.00, and an estimated conversion price of $4.15/kg U (derived from USDOE's published prices for emergency feed) yields a feed price of $110.63. The ratio C_f/C_s is, therefore, 110.63/98.95, or 1.12. Using Figure A, the corresponding optimum tails assay is about 0.22 percent U_{235}.

Since AFC contract holders have this "variable tails assay" option, and since enriched uranium costs are lowest when the customer's transaction tails assay is optimum, many AFC holders may choose to exercise the option. Much of the natural uranium currently in inventory was purchased at prices below the current market price; thus, the optimum tails assay for enriched uranium produced from that material would be higher than 0.22 percent U_{235}. For example, the optimum tails assay calculated using the 1978 average uranium feed price reported by USDOE—$21.60 per pound U_3O_8—and today's SWU price—$98.95— is about 0.28 percent U_{235}.

Enrichment prices are escalating rapidly, while market prices for natural uranium have been declining. Thus, the optimum tails assay, about 0.22 percent U_{235} under current conditions, is expected to trend upwards. If AFC customers follow this trend and select higher transaction tails assays, the result will be an increase in natural uranium consumption over what it would have been at a tails assay of 0.20 percent U_{235}. The latter is the tails assay on which most consumption predictions, including Nuexco's estimates of Apparent Future Consumption, are based, and is also the transaction tails assay for Requirements Contracts. For every one-hundredth of a percentage point increase in the transaction tails assay, uranium consumption increases about two percent. Thus, increasing the transaction tails cent U_{235} would mean a uranium feed increase of four percent in order to produce the same amount of enriched uranium, and, consequently, the same amount of electrical output. A higher average transaction tails assay will, therefore, boost uranium requirements somewhat, mitigating some of the decrease in demand which has occurred over the past few years.

Government Statistics

Beginning in this issue, Nuexco will reprint selected government indexes for Australia and Canada. The data will appear in the *Statistical Data* section, following the US Government Statistics. In this Report only, a special supplement is included giving monthly listings for each of the indexes for recent years.

Nuexco's purpose in reprinting these statistics is to illustrate typical cost patterns for uranium producers in Australia and Canada. Although Nuexco believes that these statistics are representative of uranium industry cost history, their inclusion in this list should not be taken to imply their widespread use or approval for future use in Australian or Canadian uranium sales agreements. Also, since errors in reprinting may occur, persons using these indexes for administering uranium sales agreements should make arrangements to obtain the data directly from the appropriate government sources. Nuexco would be happy to assist any Subscriber in obtaining the appropriate publications.

The remainder of this section presents a summary of the explanatory notes relevant to each of the indexes to be reprinted.

Australia—Price Index

1. The index is the "Price Index of Materials Used in Manufacturing Industry—All Groups." It measures changes in prices of materials and fuels used in manufacturing. It does not reflect changes in other important costs such as labor and capital inputs to manufacturing, and taxes incurred during manufacturing.

2. These data are reprinted from Table 3 of "Price Index of Materials Used in Manufacturing Industry," a monthly publication of the Australian Bureau of Statistics, catalogue number 6411.0.

3. The index relates only to materials used within the Manufacturing Division of the Australian Standard Industrial Classification and which have been produced outside that Division. The pricing and weights for the index reflect usage of materials at the point of entry to the Manufacturing Division.

4. Index numbers for the two most recent months are preliminary and may be revised. Figures for earlier months are generally not revised. Index numbers for financial years are simple averages of monthly index numbers.

Australia—Wage Rates

1. The index is "Weekly Wage Rates—Adult

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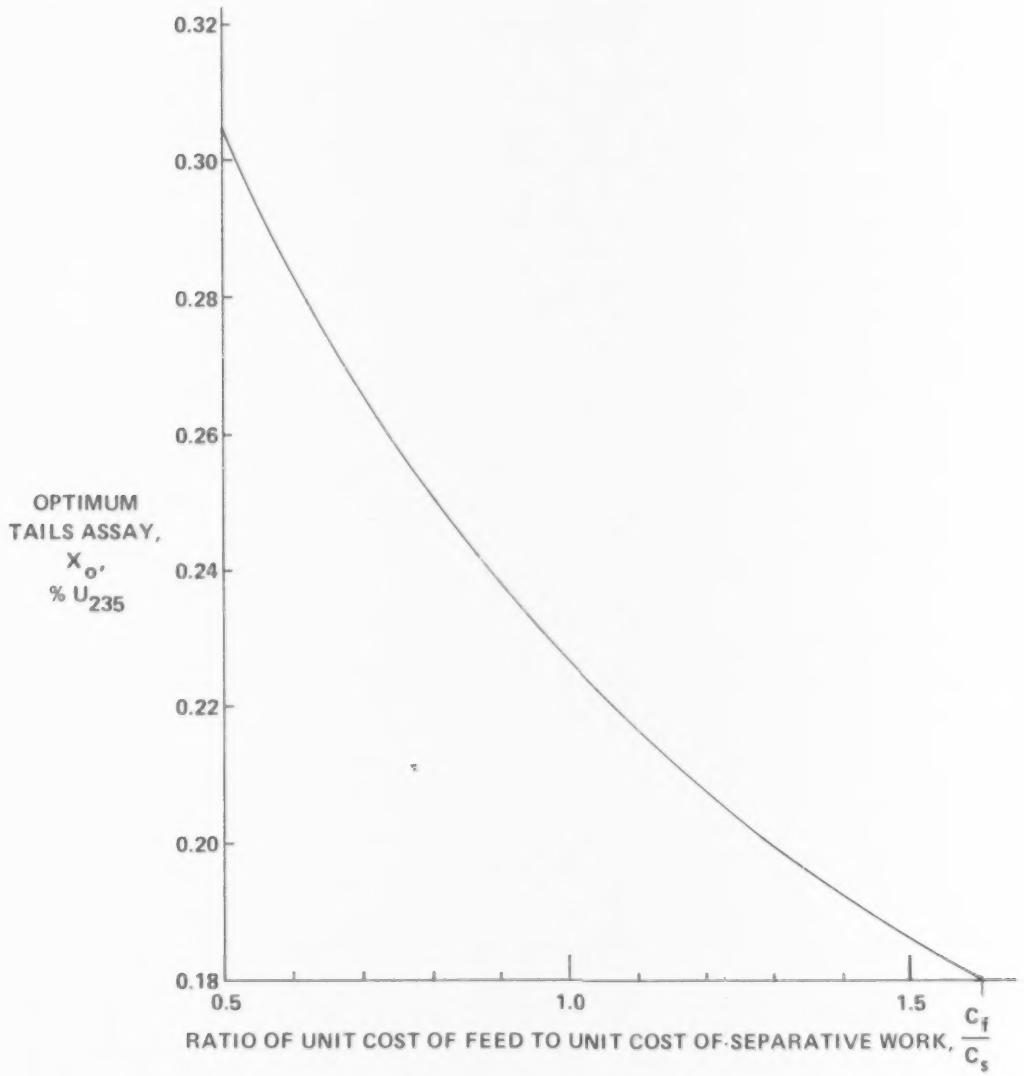

Figure A
TAILS ASSAY FOR MINIMUM COST OF PRODUCT

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Males, Mining and Quarrying, Australia." The wage rates used are the minimum rates for a full week's work (excluding overtime). In most cases, the rates are as prescribed in awards or determinations of Federal or State industrial authorities, or in collective agreements registered with them. Rates prescribed in unregistered collective agreements are used where these are dominant in the particular industries to which they refer.

2. These data are reprinted from Table 1 of "Wage Rates, Australia," a monthly publication of the Australian Bureau of Statistics, catalogue number 6312.0.

3. Payments which do not apply to all workers in a particular occupation (for example, those payable for working in wet, dirty, confined or isolated places) are not included in the wage rate data. From September 1978, the statistics include supplementary payments under the Metal Industry Award, Part 1, applicable in all states except Western Australia. In Western Australia, similar payments under the corresponding award, the Western Australian Metal Trades Award (General), have been included since January 1976.

The statistics are designed to measure trends in wage rates in current awards, etc. excluding the effects of changes in the relative importance of industries, awards and occupations. The weighted average wage rates are, therefore, indexes expressed in monetary terms, and do not purport to be actual current averages.

4. Data for the latest twelve months shown are subject to revision. As such revisions are made and published, they will be reprinted in the *Statistical Data* section of the Nuexco Monthly Report.

Canada—Price Index

1. The index is "Industry Selling Price Index: Manufacturing (D500000)." The data are reprinted from Table 1 of "Industry Price Indexes" a monthly publication of Statistics Canada, Prices Division.

2. Figures for the most recent six months shown are subject to revision. As such revisions are made and published, they will be reprinted in the next Nuexco Monthly Report.

3. The index measures pure price changes of specified commodities having a base of 1971 = 100.

4. The initial selections of responding firms and of commodities to be priced are based on a series of annual surveys collecting data on shipments of commodities, employment and materials used. Prices are f.o.b. factory gate, less discounts and before taxes. Prices are collected for new orders placed on the 15th of each month or the nearest transaction data for the commodity being priced.

5. The index is gross-weighted. It measures the movements of prices of gross shipments of manufacturing industries, including inter-industry shipments between individual industries within manufacturing. There, the movements of some prices are duplicated.

Canada—Wage Rates

1. The index is "Wage-earner Data: Average Hourly Earnings," for three SIC (Standard Industrial Classification) codes:

a. SIC 050-059; Metal Mining, Including Milling;
b. SIC 296-298; Primary Metal Industries, Non-ferrous;
c. SIC 370-379; Chemicals and Chemical Products

2. The data are reprinted from Table 2 of "Employment, Earnings and Hours," a monthly publication of Statistics Canada, Labour Division, Employment and Payrolls Section.

3. Wage-earners are employees engaged in actual production and related operations including support personnel and working foremen performing functions similar to those of the employees whom they supervise. Average hourly earnings data are computed only for those wage-earners for whom hourly details are reported.

4. Earnings represent gross pay for the week, before deductions for taxes and unemployment insurance contributions. Gross pay includes salaries, straight time wages, piece-work and regular commission earnings, regular paid incentive, cost of living and other bonuses, overtime earnings and payments to persons absent with pay in the survey reference week.

AFRICA

Calendar year 1979 uranium production in the **Republic of South Africa** is as follows:

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	Thousands of Pounds U_3O_8
Blyvooruitzicht	631
Buffelsfontein	1,367
ERGO	527
Harmony	1,193
Hartebeestfontein	868
JMS	1,534
Palaborwa	284
Randfontein	919
Stilfontein	533
Vaal Reefs	2,806
West Driefontein	635
Western Deep Levels	439
West Rand Consolidated	811
TOTAL	12,547

The total is a 22 percent increase over the 10,268,000 pounds U_3O_8 produced in 1978. The increase is largely due to the buildup of production at Randfontein and the start-up during the year of the Vaal Reefs South Vaal plant and Stilfontein's Chemwes plant. South African production will continue to increase over the next few years. Additional capacity is due on stream in 1980 at Harmony, Western Deep Levels and JMS. Uranium production is expected at Afrikander Lease in 1981, and at Beisa in 1982. In addition, it was announced this month that uranium will be produced at the Western Areas gold mine. Development of a new section containing ore high in uranium has begun, and it is expected that uranium production will commence in 1983.

With the recent astronomical rise in the price of gold, it is possible that uranium production in South Africa could be increased even further. Higher gold prices mean that more gold-bearing areas would become economically exploitable. Also, new tailings recovery operations might come under consideration. Both occurrences could lead to an increase in uranium production. On the other hand, however, most gold mines have dropped cutoff grade when gold prices increased in the past. Since gold and uranium grades tend to go together, a drop in average grade might somewhat reduce uranium production in existing mines. In fact, uranium production in three mines dropped in 1979 due to falling grade. However, if current gold price levels continue, the strong incentive for new production units will probably overshadow any production decreases due to grade reduction.

AUSTRALIA

Electrolytic Zinc (EZ) has decided to join Peko Wallsend in its purchase of the government's 50 percent share of Ranger. EZ will, like Peko, transfer its 25 percent interest in Ranger to Energy Resources of Australia (ERA), which will then hold all of the equity in Ranger. The EZ decision will probably necessitate some changes in the percentage ownerships of the various entities. Peko and EZ will be the largest shareholders, presumably, owning about 30 percent each. If 25 percent were then sold to non-Australian entities, 15 percent would be left for a public share offering in Australia.

As previously reported, Japanese, German and British interests are viewed as the most likely non-Australian equity holders. Japan's interest will be represented by several utility companies; their situation is discussed in the **Japan** section of this Report. The German interest will probably be held by Urangesellschaft and Saarberg Interplan, neither of which is an end-user, while British interests will probably be represented by the British Civil Uranium Procurement Organization.

Perhaps of greater interest to buyers than the ownership breakdown is how the material will be marketed. While many details remain to be worked out, several points are already clear. Contracts to purchase Ranger output will be between ERA and end users. Thus, the non-Australian equity holders that are end users will contract with ERA. Further, non-Australian equity holders that are not end-users must, as a precondition to such equity participation, arrange for end-users to enter into sales contracts with ERA.

It seems certain that Ranger Export Development Company (REDCO) will continue to market the Ranger production associated with the Peko and EZ interests, and it would also be logical for it to market the balance of the Australian share. At the same time, other companies have begun discussions with utility buyers regarding the Ranger production, in connection with the purchase of equity in ERA.

This has led to some confusion among buyers as to who is authorized to offer what. This confusion is a natural consequence not only of the uncertainties surrounding the formation of ERA, but also of the

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attempts by the various participants and would-be participants to establish or improve their positions in the new organization. As the structure of ERA is finalized, it is to be expected that the responsibility and authority of the parties will be better defined.

This situation notwithstanding, a letter of intent has been signed by a US utility for long-term supply from Ranger.

CANADA

In accordance with the provincial Public Inquiries Act of January 1979, British Columbia has appointed a commission to hold public hearings on all aspects of uranium mining within the province. The commission held an initial series of community hearings and technical hearings in 1979 on exploration, mining, milling, waste management and environmental impact of uranium mining. Further technical hearings are being held during 1980 in Vancouver from January through June, with additional community hearings scheduled for September to November.

The commission will require about a year to prepare a report on its findings. There is currently no uranium mining in British Columbia; however, mining of the Blizzard uranium reserves, for which a sales contract was recently signed, is subject to approval of the provincial government.

EUROPE

If renegotiation of the US/Euratom agreement for cooperation has not been completed by the March 10, 1980, deadline as set forth in the US Nuclear Non-proliferation Act of 1978, it could mean that US exports to the Euratom nations after that date would be discontinued. However, under the Act, the US President has the power to order a twelve-month extension of the deadline (which can then be extended annually for a further twelve-month period) if he feels that failure to continue cooperation with the Euratom nations "would be seriously predjudicial to the achievement of United States non-proliferation objectives or otherwise jeopardize the common defense and security," and if he notifies Congress of his intention to extend the time. The US State Department has already recommended that President Carter order the twelve-month extension, and he is expected to follow the recommendation.

JAPAN

It seems almost certain that Japanese utilities will take up approximately ten percent of the equity of Energy Resources of Australia (ERA), the new corporation that will own Ranger. The Japanese utility participants will include Shikoku, Kyushu and Kansai, although Chubu may also participate. Conspicuous by its absence is Tokyo Electric Power Company (TEPCO), Japan's largest utility, which has shown no interest, presumably because it will have a uranium inventory of nearly 10,000,000 pounds U_3O_8 during the 1980's.

While a ten percent equity position in ERA translates into only about 650,000 pounds U_3O_8 annually, such participation would place the Japanese in a favored position to purchase additional material under conventional contracts. However, Japanese participation in this project has, from the outset, been marked by a curious lack of enthusiasm. This suggests:

- —That their participation is based more on the importance of general Australian-Japanese trade relations than on any great need for uranium in the 1980's.
- —Recognition of the fact that Japan has already contracted for substantial tonnage from Australia, not only from Ranger, but also from Queensland Mines and Mary Kathleen.
- —Recognition that, in the aggregate, Japan's existing and projected inventory is already extremely large, and growing.

It can be concluded that, in the near term, Japanese buyers will be increasingly selective in their procurement, particularly if prices continue to be weak.

UNITED STATES

This month, two tentative settlements in the series of utility lawsuits with Westinghouse Electric Corporation were announced, leaving only two of the original 17 lawsuits unresolved. As in previous settlements, Westinghouse will deliver some uranium as well as provide cash, equipment and services. The settlements thus far account for about 85 percent of the uranium originally involved in the litigation, some 65,000,000 pounds U_3O_8.

Six US nuclear power units were officially canceled this month. The Central Area Power Coordi-

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nating Group (CAPCO) announced the cancellation of Eire 1 & 2, and Davis-Besse 2 & 3. Long Island Lighting Company announced the cancellation of Jamesport 1 & 2. Regulatory problems were cited as primary reasons for all six cancellations.

The near-term market in the US was active this month. Leading the activity was the inquiry from the Federal Republic of Germany to purchase 1,000,000 pounds U_3O_8 for 1980 delivery, in connection with the offset agreement between the US and the FRG. The due date for offers was January 25, and response to the invitation was enthusiastic. The total quantity of material offered by US sellers amounted to about 6,000,000 pounds U_3O_8, or six times the amount of the inquiry. The German government will decide during February which offers to select.

This request for offers was sent to virtually every uranium producer and nuclear utility in the US. Of the responses received, most were from inventory holders. The large quantity of material offered indicates that there is more material available for sale in the US market than is being actively offered at this time. This widely publicized request for offers may have caused a few utilities to revaluate their inventory positions to make material available for sale. The offers were generally made at fixed prices, most being below last month's Exchange Value.

Besides the German offset, there is additional active demand in the US market, and more appears to be forming. A few utilities have been attracted into the near-term market by declining prices, and they may purchase small amounts of material. Also, declining ore grade and rising production costs, combined with lower prices, may put some US suppliers in the position of making spot purchases of material to deliver under current contracts, in lieu of producing the material themselves.

PRICING

The **Exchange Value** decreased again this month to $40.00 per pound U_3O_8, a decline of $0.75. Utility inventory sellers have been, and continue to be, a significant factor in the price decline. With its regulatory and tax implications, the decision to sell inventory is both difficult and unusual for utilities. Once the decision is made, however, disposal of the material tends to take priority over price.

Thus, the active price competition in the current market is primarily among inventory sellers. Uranium producers themselves have not been as active for the following reasons:

—Producer resistance has hardened as the market approached the $40.00 level.

—Due to falling grade, there is little excess production available to sell on the spot market.

—Some producers with adequate cash flow have indicated their determination to hold excess production off the market if they consider prices too low.

—Finally, some higher-cost producers are considering the economic benefits of purchasing, rather than producing, the concentrates needed to fulfill delivery obligations.

This situation suggests that producers will probably make few sales in the spot and near-term markets, until such time as the redistribution of inventory has been completed and new demand is placed on conventional supply sources.

A weakening price structure is also likely to impede intermediate and longer-term contracting. Producers will be more reluctant than ever to contract without some type of floor-price mechanism. The same price weakness raises concern among utilities that formula prices, if not well below present market levels, may exceed market by the time of delivery. Such a price spread is becoming increasingly difficult to attain, because costs are rising and prices are declining.

The **Transaction Value** also decreased this month to $42.00 per pound U_3O_8 as new, lower-priced transactions were added to the sample. The **Loan Use Charge Rate** remained at seven percent per annum. Uranium available for loan has increased dramatically in recent months *(see Market Opportunities)*. Although no loans closed this month, several are in serious negotiation, and the rates being discussed are generally around the seven percent level.

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TOPICAL ESSAY

FORWARD COST

Introduction

As used in the computation of uranium reserves, the term *forward cost* has been subject to misunderstanding and misuse. This discussion is intended to help clarify what the term means and, equally important, what it does not mean.

In calculating ore reserves* in a given cost category, the US Department of Energy (USDOE) defines forward cost as all capital and operating expenditures incurred after the date of the ore reserve estimate, in building, maintaining and operating new and existing uranium mine and mill facilities.

Analyses of reserves based on forward cost are primarily useful for estimating the long-range sufficiency of uranium, and for estimating the economic competitiveness of domestic reserves versus potential foreign supplies. The information can be used to formulate government and industry strategy on uranium supply, to develop long-range exploration planning by the uranium industry, and to aid utilities in planning long-term uranium supply strategies and evaluating fuel supply for future power generation alternatives.

Forward Cost vs. Price

The forward cost associated with a uranium reserve must not be confused with the price at which production from that reserve could be sold on an economical basis. The most important consideration in reserve assessments made by USDOE is whether or not a given reserve can be produced within a certain unit cost range (i.e. meet direct and indirect operating costs, and recover forward capital costs for each unit produced). The considerations of the owner of the reserve are usually quite different. The owner will consider the reserve economically exploitable only if its production can be sold at a price which will not only cover the forward costs, but also capital already spent, and earn an acceptable return on investment commensurate with the risks involved.

*The term *reserves*, as used by USDOE, is roughly synonymous with the term *reasonably assured resources* used by the International Atomic Energy Agency. The two are often used interchangeably.

Factors Included in Forward Cost Estimates

The factors included in USDOE forward cost estimates are tabulated in Table A. The forward cost basis for classification of reserves is practical from USDOE's standpoint, since it does not require complete data regarding the timing and magnitude of past expenditures by the operating companies—data which are sometimes difficult to obtain. Also, information is not required on the operating companies' opportunities for alternate investments, policies on rate of return on investments, tax considerations, interest costs, etc.

Forward cost estimates include only expenditures yet to be made for direct and indirect capital and operating costs at the time of the estimate. To better understand what is excluded, it is instructive to examine the definition carefully.

Funds already spent, i.e. *sunk costs*, are not included in forward cost estimates. Usually, substantial capital costs have been incurred prior to establishing a reserve to the point where a determination can be made to proceed with development. Therefore, for USDOE reserve analyses, the total cost of land acquisition and exploration and development drilling are not included in the forward cost estimates. Also, for reserves associated with production facilities currently in operation or under construction, all, or nearly all, of the project capital will have been invested already, and will not be included as a forward cost.

Inflation is also excluded, even though forward costs are future expenditures. Of course, inflation is taken into account as forward cost estimates are periodically updated. Over the years, this effect usually leads to erosion of reserves in the lower forward cost categories.

Only direct and indirect operating and capital expenditures are considered. Since USDOE is not in a position to assess the cost of money and tax situation for the individual operating companies, these factors are left out of the calculation entirely. Thus, *return on investment* (profit or earnings), *interest* on debt, and federal and state *income taxes* are not included in the estimates. Forward costs associated with environmental regulations are included to the extent that they are known at the time the estimate is performed. That is, only environmental requirements as of the date of the estimate are included.

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TOPICAL ESSAY

Table A

COST ELEMENTS OF USDOE URANIUM ORE RESERVES ESTIMATES

Category	Cost	Description of Cost Element
Capital Costs (Applied only on a forward-cost basis)	Acquisition	Includes cash purchase, stock transfer, concession, lease or claim location. Acquisition costs for properties acquired prior to current evaluation are not considered.
	Surface Exploratory Drilling	Drilling carried out to discover ore in favorable areas (consists of widely-spaced drill holes).
	Surface Developmental Drilling	Drilling carried out to define U_3O_8 grade distribution (consists of closely-spaced drill holes).
	Mine Surface Plants	Surface installations and associated equipment, including hoists, headframes, shops, shop equipment and grade control stations.
	Mine Equipment	All underground or open-pit mining equipment required to extract ore from a deposit.
	Mill Construction	Includes site preparation, material, labor, supervision, engineering and equipment involved in constructing a processing plant.
	Primary Development	All operations involved in developing an orebody preparatory to actual mining. Includes shaft-sinking, stations, pumping levels, haulage drifts, raises, inclines, ventilation shafts, emergency exits and long-hole drilling for underground mines, and overburden-stripping and ramp construction for open-pit mines. Also includes a proportionate share of general and administrative expenses.
Operating Costs	Mining Operations	All direct and indirect costs involved in extracting ore from a deposit after access has been made to its underground location. Included are costs for supervision, engineering, power, materials, labor, payroll taxes and land reclamation. Also included are costs for production taxes imposed by states and counties, property taxes, insurance, and a proportionate share of general and administrative expenses.
	Haulage	Cost of loading and transporting ore from mine site to mill.
	Royalty	Payments to landowners or controllers, usually as a percentage of the gross value of ore delivered to the mill.

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TOPICAL ESSAY

Likewise, only severance taxes in existence at the time of the estimate are included.

Return on Investment

The uranium industry is capital-intensive. Large amounts of money must be spent over a long period of time before a project has been completed and begins to yield a return on the investment (ROI). Also, like most mineral industries, uranium development is viewed as relatively risky, and a high expected ROI is normally required for a uranium project to be developed. In such a capital-intensive project, where money is spent well in advance of earnings, ROI and associated taxes will normally represent a substantial part of the selling price. While difficult to quantify, a rule of thumb for conventional uranium projects exists: if an after-tax, discounted cash flow ROI of fifteen percent is desired, then for every dollar of capital investment, it is necessary to generate five to seven dollars of gross revenue in order to recover ROI, interest, income taxes and capital. This assumes that the percentage depletion allowance for uranium currently available in the US remains in effect. The characteristics of the individual project and the financial and tax status of the operating company will determine where, within this range, each situation falls.

A question often asked when forward cost is discussed is whether there is a factor which, when multiplied by the USDOE forward cost estimate for a reserve, would yield the selling price necessary to make the reserve viable. A general rule of thumb in this regard can be stated; however, in so doing, it is important to note that reserves are usually classified in specific forward cost categories characterized by upper cutoff costs. The average forward cost of reserve units contained within any given cost category will be less than the upper cost cutoff. The upper cost cutoff is the cost at which all reserves in that cost category could be recovered, but each category contains a distribution of costs for reserves within that category.

Nuexco estimates that the approximate ratio of selling price to forward cost for a typical reserve recoverable by conventional methods is in the range of 1.5 to 1.75 for a 15 percent after-tax discounted cash flow return on investment. For a 20 percent return on investment, the ratio would be in the range of 1.7 to 2.0. The characteristics of the individual project and the financial and tax status of the operating company will determine where each particular reserve unit falls.

Conclusion

Forward cost is clearly defined for purposes of estimating reserves. For various reasons, forward cost estimates are often used by industry participants to draw inferences regarding future prices. Several important cost factors are omitted from forward cost estimates, so care should be taken in making any such inferences.

The most important items excluded from forward cost estimates are: sunk costs (especially for production centers operating or under construction), return on investment, interest, and federal and state income taxes.

Due to these exclusions, there will generally be a substantial gap between the estimated forward cost of an ore reserve, and the selling price needed to develop it viably.

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BY-PRODUCT URANIUM FROM PHOSPHATE—PART III

Uranium Recovery Technology

A process for extracting uranium from phosphoric acid was first developed during an intensive research and development (R&D) program sponsored by the US Atomic Energy Commission (USAEC) in 1947. Four US producers of phosphoric acid participated in the program and were instrumental in developing a recovery process which became known as the Pyro solvent extraction process, or the OPPA process.[1] Three of the four companies recovered uranium on a limited basis at their respective phosphoric acid plants, producing approximately 1,000,000 pounds U_3O_8 during the period 1954 to 1962. At that point, uranium production from phosphoric acid became noncompetitive with increasing output from uranium mines in Wyoming and New Mexico, and, consequently, came to an end.

At the Oak Ridge National Laboratory in Tennessee, recovery R&D continued throughout the 1960's and early 1970's, resulting in the development of two additional recovery processes utilizing improved solvents and new technology. The DEPA-TOPO process was developed in the late 1960's, and the OPAP process around 1974.[2] All three of the processes are presently used in recovering uranium from phosphoric acid.

Interest in the recovery of uranium as a by-product of phosphoric acid production was renewed by private industry in the late 1960's. The three processes are basically the same recovery methods used today; the principal difference among them is the pre-treatment of the acid stream. Florida phosphorites contain about one percent organic materials, and their removal from the acid stream is essential to economical uranium recovery.[3] This stage in the process is usually regarded as proprietary, and the technology and application vary among producers.

Recovery Activity in the US and Canada

In 1975, UNC Recovery Corporation constructed the first new generation uranium recovery plant at the phosphoric acid facility of W. R. Grace & Company near Bartow, Florida, following six to eight capacity of 330,000 pounds U_3O_8 per year.[4] The recovery process closely parallels the two-stage OPAP process—organic washing, solvent extraction, and stripping of uranium from the solvent is completed at the site of the phosphoric acid plant; the pregnant solution is then trucked to a central processing plant for purification and U_3O_8 concentration. UNC Recovery Corporation has the option to build a second production center with a capacity of 440,000 pounds U_3O_8 per year.

Wyoming Mineral Corporation (WMC), a wholly-owned subsidiary of Westinghouse Electric Corporation, initiated R&D for the recovery of by-product uranium in 1970, working jointly in 1972 with Gardinier, Inc., of Tampa, Florida. Later, WMC contracted to recover uranium from the Farmland Industries, Inc., phosphoric acid facility at Pierce, Florida. WMC designed and built a uranium recovery plant with an annual capacity of 400,000 pounds U_3O_8. The plant began operating in late 1978, and presently functions near capacity. Farmland is the operator, but all production goes to WMC. WMC contemplates eventual participation in additional recovery projects with phosphoric acid producers in other countries. Following pre-treatment of the acid stream, WMC uses what is basically the DEPA-TOPO process to recover U_3O_8.

Freeport Uranium Recovery Company, a subsid-

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[1]The fundamental process consists of reduction of uranium contained in phosphoric acid by the addition of iron; solvent extraction utilizing octyl pyrophosphoric acid diluted with kerosene; clarification of the loaded solvent; stripping/precipitation and purification; and drying of the uranium.

[2]The two-stage DEPA-TOPO process uses a solvent lmixture of di(2-ethylhexyl) phosphoric acid and trioctyl phosphine oxide to extract, concentrate and purify the uranium. The OPAP process uses the solvent octylphenyl acid phosphate to concentrate the uranium in the first stage of the process. The uranium is extracted and purified with DEPA-TOPO solvent in the second stage.

[3]Uranium cannot be economically recovered from phosphoric acid containing organic material, which is dark in color and is referred to as "black" or "brown" acid. The acid must be cleaned by removing the organic material. It is then referred to as "green" acid. Uranium is more readily recovered from the "green" acid.

[4]Production capacity for all uranium plants is based on phosphoric acid production. Actual uranium content of phosphate rock commonly varies within the deposit and from deposit to deposit. Uranium production therefore varies and capacities herein referred to are approximate.

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iary of Freeport Minerals Company, has constructed a recovery plant at its phosphoric acid facilities near Uncle Sam, Louisiana. Although Freeport's pre-treatment technology is proprietary, the basic recovery method is the DEPA-TOPO process. Plant start-up was early in 1979, and production exceeded 600,000 pounds U_3O_8 for that year, making it the most successful operation to date. Design capacity is 690,000 pounds U_3O_8 per year. It is anticipated that design capacity will be achieved during 1980, the first full year of operation. Freeport has arranged long-term sales contracts for the output of this plant.

Freeport is financing the construction of an additional recovery plant under an agreement with the Agrico Chemical Company in connection with its phosphoric acid operation near Donaldsonville, Louisiana. The new plant is scheduled for start-up about mid-1980 and will have a design capacity of 420,000 pounds U_3O_8 per year. Freeport is to be the operator of the recovery plant, and will receive all uranium concentrate produced. Freeport has arranged long-term sales contracts for all uranium production from this plant.

Gardinier, Inc., assumed full operating responsibility for its uranium recovery plant in East Tampa, Florida, as of June 1979. The plant has a design capacity of 425,000 pounds U_3O_8 equivalent per year. Plant output will actually be in the form of UF_4. The production rate is presently approaching design capacity. The uranium is recovered by a modified, technically improved OPPA process. Gardinier is the only company currently producing UF_4. It has arranged a long-term sales contract for the output of this plant.

International Minerals & Chemical Corporation (IMC) has been involved in the recovery of by-product uranium since participating in the USAEC R&D program in the 1950's. After years of additional work, IMC built a pilot plant adjacent to its new phosphoric acid facilities at New Wales, Florida, in 1977, and started construction of the world's largest plant for by-product uranium recovery at the same site in 1978. This plant is scheduled for completion in March 1980. Its design capacity is 800,000 pounds U_3O_8 per year, and IMC expects to be in full production by late 1980.

IMC will construct additional recovery units at the two acid plants owned by CF Industries, one located in Bartow, and the other at Plant City, Florida. Both recovery units are scheduled for completion by early 1981. Combined design capacity will be 1,200,000 pounds U_3O_8 annually. The product from each primary unit will be transported to the main recovery facility at New Wales for final processing. IMC will operate both plants and receive all uranium concentrate production.

IMC uses the basic DEPA-TOPO process, with one significant variation. Activated carbon is used to remove organic material from the acid stream. Second-phase treatment requires the application of an organic solvent, which extracts uranium from the phosphoric acid. The uranium is then separated from the solvent for final extraction and purification. IMC expects that extraction efficiency will be about 90 percent. IMC has arranged long-term sales contracts for all uranium concentrate recovered in these plants.

There is only one uranium-from-phosphate recovery operation in North America outside Florida and Louisiana. Earth Sciences, Inc. (ESI), of Golden, Colorado, and Western Cooperative Fertilizers Ltd. (WCFL) of Calgary, Alberta, have entered into an agreement under which the ESI group financed and constructed a plant to recover uranium from the WCFL phosphoric acid facility at Calgary. The plant is in the last stages of construction, with start-up scheduled for February or March 1980. Annual design capacity is 120,000 pounds U_3O_8. ESI will operate the plant and take delivery of all uranium produced. It has an option to build a second recovery unit of about the same size for the WCFL phosphoric acid plant at Medicine Hat, Alberta. Construcion is tentatively scheduled to begin in early 1981.

The phosphate ore for the WCFL plant is mined by open pit methods from a mine near Conda, Idaho, and transported by rail to the phosphoric acid plant at Calgary. The uranium recovery process used is a modification of the OPAP process. The solution is reduced rather than oxidized, followed by final-stage solvent extraction and purification.

Two additional producers of phosphoric acid in Idaho are considering the recovery of uranium. The J. R. Simplot Company recenlty completed a successful pilot test for uranium recovery at its Don phosphoric acid plant in Pocatello. The company announced in December that construction of a com-

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mercial recovery plant at the Don site would begin about mid-1980. The design capacity will be 120,000 pounds U_3O_8 per year. The basic recovery method used will be the DEPA-TOPO process, modified to accommodate phosphoric acid made from calcined phosphate rock.[5] An important difference between the J. R. Simplot recovery process and the processes in use elsewhere is that the end product at the Don facility will be a high-grade uranium slurry. In addition, the process includes the recovery of vanadium, which averages about 2.5 pounds V_2O_5 per ton of phosphoric acid. The vanadium will be recovered in solution form for processing later.

Becker Industries Corporation recently announced its intent to construct a pilot plant for uranium recovery at its phosphoric acid facility near Conda, Idaho. The pilot plant will be financed by Mono Power Company, a subsidiary of the Southern California Edison Company. If the pilot project is successful, the companies which will have an annual capacity of 200,000 pounds U_3O_8. The recovery of by-product vanadium will also be considered. Construction of the pilot plant is scheduled to begin in mid-1980.

Table B is a summary of projects involving uranium recovery from phosphoric acid. Plant capacities are approximate. The uranium contained in an acid stream is subject to variations in plant feed quality and quantity (cf. footnote 4 above). The amount of uranium recovered from the acid stream will vary from about 75 to 90 percent, depending upon the efficiency of the recovery technique; however, annual uranium production from phosphoric acid could, under ideal operating circumstances, total about 4,400,000 pounds U_3O_8 by the end of 1981, and about 4,800,000 pounds by 1983.

Summary

The recovery of uranium from phosphoric acid is not a new idea—it is a rejuvenated one, brought to life again by the development of new recovery technology at a time when the demand for, and value of, uranium concentrates were steadily increasing. As a show of confidence in the new technology and the uranium market, six companies in North America will have invested well over $220,000,000 by the end of 1980 in uranium recovery from phosphates.

In general, the US phosphate industry has the capacity of rapidly expanding uranium recovery well beyond the present level on the basis of in-place phosphoric acid production capacity. The greatest potential for expansion is in the central Florida district, where the amount of uranium contained in the rock, as well as wet-process phosphoric acid production, is highest. The growth potential for uranium production from western phosphoric acid will be minor, compared to that of the Florida operations. However, it is doubtful that overall recovery capacity will continue to expand, due to the declining price of uranium.

[5]Western phosphorites contain about 4 percent organic material which is recovered during a calcining process prior to the production of green acid.

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Table B
SUMMARY OF OPERATIONS FOR RECOVERY OF URANIUM FROM PHOSPHORIC ACID

Company	Plant Location	Design Capacity Pounds U_3O_8 /yr.	Status
Facilities Operating or Under Construction			
UNC Recovery Corporation at W.R. Grace & Co.	Bartow, Florida	330,000	Operational
Wyoming Mineral Corporation at Farmland Industries	Pierce, Florida	400,000	Operational
Freeport Uranium Recovery Co.	Uncle Sam, Louisiana	690,000	Operational
Freeport plant at Agrico Chemical Co.	Donaldsonville, Louisiana	420,000	Start-up mid-1980
Gardinier, Inc.	Tampa, Florida	425,000	Operational
International Minerals & Chemical Corporation	New Wales, Florida	800,000	Start-up March 1980
IMC plant at C.F. Industries, Inc.	Plant City, Florida	600,000	Start-up by early 1981
IMC Plant at C.F. Industries, Inc.	Bartow, Florida	600,000	Start-up by early 1981
Earth Sciences, Inc., at Western Cooperative Fertilizers, Ltd.	Calgary, Alberta	120,000	Start-up February or March 1980
	Total annual recovery capacity =	4,385,000	
Facilities Planned			
J.R. Simplot Company at Don Plant	Pocatello, Idaho	120,000	Construction begins mid-1980
Earth Sciences, Inc., at Western Cooperative Fertilizers, Ltd.	Medicine Hat, Alberta	120,000	Option to build
Becker Industries Corporation at Conda Mine area	Conda, Idaho	200,000	Pilot test planned
	Total planned capacity =	440,000	

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STATISTICAL DATA

EXCHANGE VALUE — $40.00/lb U_3O_8

DEFINITION

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

DERIVATION

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

COMMENTS

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE			
$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
42.00	2.3	14	7

DEFINITION

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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STATISTICAL DATA

Figure 1
HISTORICAL EXCHANGE VALUES

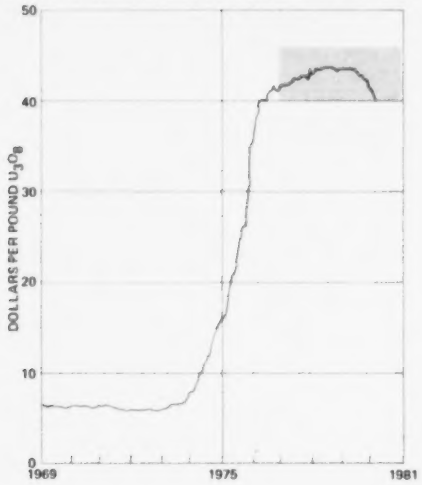


Figure 2
HISTORICAL TRANSACTION VALUES

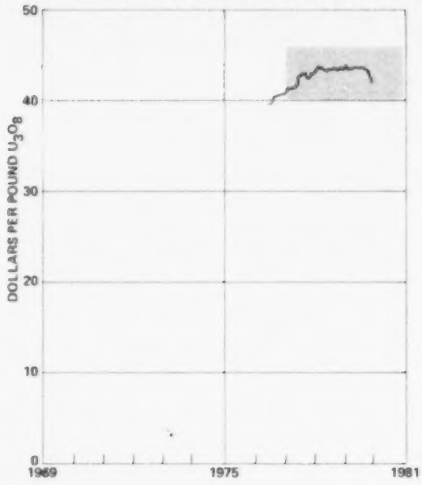
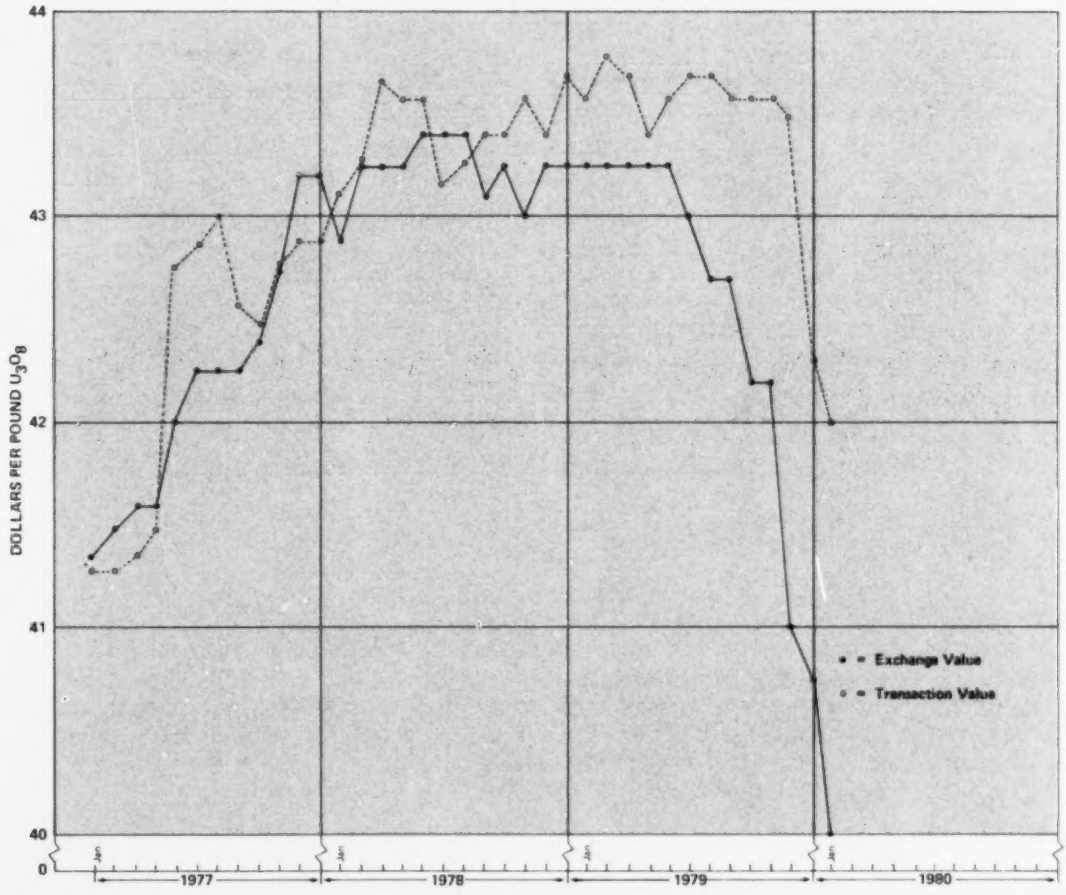


Figure 3
RECENT EXCHANGE AND TRANSACTION VALUES



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STATISTICAL DATA

EXCHANGE VALUE
US Dollars/lb U_3O_8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00											

Note: See earlier Nuexco Reports for evolution of the definition of Exchange Value.

TRANSACTION VALUE
US Dollars/lb U_3O_8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00											

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STATISTICAL DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	40.00	88.18	103.99
France (franc)	162.60	358.47	422.73
FRG (mark)	69.50	153.23	180.70
Japan (yen)	9,551	21,057	24,831
Switzerland (franc)	64.88	143.04	168.68
UK (pound)	17.67	38.95	45.93
Australia (dollar)	36.07	79.52	93.77
Canada (dollar)	46.46	102.42	120.78
Niger, Gabon (CFA)	8,130	17,924	21,136
South Africa (rand)	32.68	72.05	84.96

* Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

LOAN USE CHARGE RATE — 7.0%/year

DEFINITION

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

DERIVATION

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.
B. Rates included in firm proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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CURRENT TRANSACTIONS*

Ref	Delivery Period	Approximate Quantity	Approximate Price as % of Current E.V.	Seller Group	Buyer Group	Remarks
1025	83	100,000 to 300,000 lbs U_3O_8	88%	US	Europe	Not an arm's length transaction
1027	82-90's	2,000,000 to 4,000,000 lbs U_3O_8	–	US	US	Price related to market at time of delivery
1030	80	100,000 to 300,000 lbs U_3O_8	100%	US	US	
1032	80-83	2,000,000 to 4,000,000 lbs U_3O_8	–	US	Pacific Basin	Price related to market at time of delivery

* Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[2]		
		Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970[3]	110.0	3.88		3.69
Annual Avg. 1971[3]	114.0	4.12		3.94
Annual Avg. 1972[3]	117.9	4.49		4.21
Annual Avg. 1973[3]	125.9	4.82		4.48
Annual Avg. 1974[3]	153.8	5.43		4.85
Annual Avg. 1975[3]	171.5	6.13		5.37
Annual Avg. 1976[3]	182.3	6.75		5.89
Annual Avg. 1977	195.1[4]	7.27[4]	7.66[5]	6.39[4]
Annual Avg. 1978	209.4	8.26	8.56	7.01
Oct 1978	214.7	8.60	8.84	7.19
Nov 1978	216.0	8.71	8.87	7.22
Dec 1978	217.2	8.72	8.97	7.28
Jan 1979	220.0	8.71	9.01	7.32
Feb 1979	222.5	8.81	9.02	7.32
Mar 1979	225.4	8.84	9.11	7.36
Apr 1979	229.0	9.03	9.49	7.50
May 1979	231.6	9.06	9.15	7.47
Jun 1979	234.0	9.09	9.44	7.53
Jul 1979	237.5	9.32	9.57	7.60
Aug 1979	240.6R	9.38	9.70	7.65
Sep 1979	243.8	9.63	9.79	7.73
Oct 1979	248.5	9.67	9.87	7.82
Nov 1979	250.2	9.79P	9.91P	7.86P
Dec 1979	252.8			7.92P

P = Preliminary
R = Revised

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2.

(3) Monthly data for these years appear in Section 10 of Report No. 107, dated June 30, 1977.

(4) 1977 monthly data for Producer Price Index, SIC 10 and SIC 28, appear in Report No. 121, dated August 31, 1978.

(5) 1977 monthly data for Producer Price Index, SIC 333, appear in Report No. 125, dated December 31, 1978.

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AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry — All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates — Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970[3]	101.4	59.88
Annual Avg. 1971[3]	101.5	65.95
Annual Avg. 1972[3]	105.6	71.26
Annual Avg. 1973[3]	124.4	78.96
Annual Avg. 1974[3]	141.9	108.07
Annual Avg. 1975[3]	150.4	132.55
Annual Avg. 1976[3]	168.4	160.93
Annual Avg. 1977[3]	192.0	179.03
Annual Avg. 1978[3]	215.4	190.04
Sep 1978	228.1	190.26
Oct 1978	230.3	190.56
Nov 1978	232.2	190.86
Dec 1978	235.7	199.27
Jan 1979	246.3	199.76
Feb 1979	253.0	200.00
Mar 1979	264.0	201.44
Apr 1979	273.0	202.27
May 1979	287.5	203.37
Jun 1979	293.8	209.87
Jul 1979	295.8P	210.48
Aug 1979	290.8P	211.56
Sep 1979	—	212.33
Oct 1979	—	211.86

P = Preliminary
R = Revised

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest twelve months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Report No. 138, dated January 31, 1980.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

Price Index of Materials Used in Manufacturing Industry
All Groups [1]

	1978	1977	1976	1975	1974	1973	1972	1971	1970
January	197.7	183.4	160.7	144.5	135.1	109.3	101.3	99.0	101.9
February	201.4	187.3	161.1	144.3	139.4	117.9	102.7	100.0	102.3
March	200.7	190.8	161.5	145.8	139.4	122.9	102.7	100.4	103.1
April	203.6	193.1	162.0	148.8	142.2	120.9	102.1	100.5	103.9
May	204.6	193.2	163.8	148.1	142.9	121.6	103.1	101.0	103.6
June	212.2	194.0	167.3	146.7	140.1	122.9	103.3	102.0	102.8
July	216.7	193.3	170.8	148.8	145.8	125.8	106.5	103.9	102.4
August	221.8	194.2	174.0	151.2	146.1	130.0	108.9	104.4	100.3
September	228.1	195.1	174.7	154.4	140.9	130.1	109.5	103.3	99.8
October	230.3	193.7	174.7	157.0	143.1	128.8	109.0	102.3	99.2
November	232.2	191.4	171.3	157.1	142.9	130.2	108.8	100.9	98.0
December	235.7	194.5	179.1	157.9	144.7	132.4	109.1	100.8	99.0
Annual Average	**215.4**	**192.0**	**168.4**	**150.4**	**141.9**	**124.4**	**105.6**	**101.5**	**101.4**

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

Weighted Average Minimum Weekly Wage Rates
Adult Males – Mining and Quarrying (A$)[1]

	1978	1977	1976	1975	1974	1973	1972	1971	1970
January	185.53	169.15	147.08	122.41	82.47	73.41	68.93	63.76	59.26
February	188.83	169.86	156.77	122.79	85.48	73.76	68.91	63.73	59.45
March	188.92	175.72	156.82	123.16	99.74	75.72	69.14	63.71	59.55
April	188.24	176.50	156.93	123.60	101.78	75.85	69.41	64.60	59.61
May	188.11	180.27	160.74	128.53	111.55	79.46	71.59	64.71	59.65
June	189.88	180.11	161.38	128.05	112.11	80.22	71.89	65.27	59.57
July	189.99	180.27	161.78	127.64	113.13	80.51	72.23	65.56	59.59
August	190.04	183.04	164.60	127.63	112.35	81.15	72.19	65.65	59.82
September	190.26	182.78	164.87	146.00	117.17	81.68	72.30	68.09	59.73
October	190.56	182.64	164.60	146.89	118.55	81.77	72.38	68.51	60.67
November	190.86	182.67	167.62	146.91	119.66	82.02	72.82	68.76	60.85
December	199.27	185.37	168.02	147.00	122.79	82.16	73.30	69.04	60.83
Annual Average	**190.04**	**179.03**	**160.93**	**132.55**	**108.07**	**78.96**	**71.26**	**65.95**	**59.88**

(1) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1], [2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings ($C)[3], [4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Sep 1978	194.0	9.04	6.89	7.10
Oct 1978	197.6	9.20	7.04	7.13
Nov 1978	198.6	9.18	7.09	7.14
Dec 1978	199.4	9.29	6.93	7.14
Jan 1979	204.8	9.19	7.14	7.29
Feb 1979	208.5	9.24	7.18	7.36
Mar 1979	210.4	9.47	7.20	7.51
Apr 1979	212.8	9.68	7.26	7.63
May 1979	214.5	9.65	7.28	7.61
Jun 1979	216.0	9.49	7.27	7.66
Jul 1979	218.2	9.37	7.34	7.73
Aug 1979	219.8	9.56	7.38	7.77
Sep 1979	223.2	9.75	7.50	7.81
Oct 1979	226.7	9.89P	7.54P	7.88P
Nov 1979	227.4			

P = Preliminary
R = Revised

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Report No. 138, dated January 31, 1980.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Report No. 138, dated January 31, 1980.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

Industry Selling Price Index: Manufacturing (D500000)[1]

(1971 = 100.0)

	1978	1977	1976	1975	1974	1973
January	181.5	167.5	158.4	149.3	127.2	108.7
February	182.8	168.8	158.6	150.0	129.1	109.8
March	184.4	171.1	159.2	150.0	131.1	111.3
April	187.2	172.9	159.9	151.4	133.9	112.4
May	188.0	173.9	160.9	152.8	135.7	114.1
June	189.0	174.1	161.5	152.8	136.7	115.0
July	190.1	175.3	161.9	153.9	139.7	116.7
August	191.7	175.8	162.2	155.2	141.8	120.2
September	194.0	176.9	163.4	156.3	143.1	119.9
October	197.6	177.8	163.4	157.4	145.0	120.6
November	198.6	178.6	163.6	157.3	147.0	121.3
December	199.4	179.2	165.6	157.6	147.4	122.8
Annual Average	**190.4**	**174.3**	**161.6**	**153.7**	**138.1**	**116.1**

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

Wage-earner Data: Average Hourly Earnings ($C)[1]

	Metal Mining, Including Milling (SIC 050-059)		Primary Metal Industries, Non-ferrous (SIC 296-298)		Chemicals and Chemical Products (SIC 370-379)	
	1978	1977	1978	1977	1978	1977
January	8.43	7.82	6.70	6.30	6.73	6.23
February	8.53	7.86	6.70	6.26	6.75	6.30
March	8.45	8.02	6.75	6.34	6.84	6.33
April	8.49	8.08	6.73	6.45	6.87	6.40
May	8.51	8.13	6.76	6.50	6.94	6.50
June	8.71	8.15	6.86	6.55	6.95	6.61
July	8.64	8.14	6.66	6.53	6.98	6.61
August	8.70	8.14	6.70	6.57	7.03	6.55
September	9.04	8.33	6.89	6.65	7.10	6.72
October	9.20	8.42	7.04	6.69	7.13	6.63
November	9.18	8.52	7.09	6.60	7.14	6.64
December	9.29	8.57	6.93	6.57	7.14	6.65
Annual Average	8.76	8.18	6.82	6.50	6.97	6.51

(1) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

SUPPLY

Uranium Available for Sale

Delivery Year	Pounds U_3O_8 (1000's)	Nuexco Reference Number	Remarks
1980	25	1358	
	50	1345	
	200	1236	
	1000	1325	
	100	1292	
	500	1333	
	400	1346	
	250	1338	
	400	1274	
	350	1284	
	250	1353	
	500	1285	
	100	1359	
1981	100	1306	
	300	1274	
	300	1286	
	500	1324	
	200	1236	
	250	1333	
1982	300	1274	
	200	1306	
	300	1286	
	200	1315	
	200	1236	
	250	1333	
1983	300	1286	
	200	1306	
	200	1315	

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

SUPPLY

Uranium Available for Loan

Delivery Year	Return Year	Pounds U_3O_8 (1000's)	Nuexco Reference Number	Remarks
1980	1982	725	1175	UF_6
	1982	600	1354	
	1982	600	1355	
	1983	2000	1136	UF_6
	1983	1000	1239	UF_6
	1983	700	1234	

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MARKET OPPORTUNITIES

DEMAND

Inquiries to Purchase Uranium

Delivery Year	Pounds U_3O_8 (1000's)	Nuexco Reference Number	Remarks
1980	450	1337	
	1000	1334	
	500	1335	
	100	1362	
1981	250	1337	
	800	1260	
	300	1357	
1982	300	1146	
	300	1227	
	250	1337	
	400	1321	
1983	400	1321	
	250	1322	
	300	1227	

Inquiries to Borrow Uranium

Delivery Year	Return Year	Pounds U_3O_8 (1000's)	Nuexco Reference Number	Remarks
1980	1981	500	1120	
	1982	500	1121	
	1983	1000	1240	
	1983	500	1348	
	1983	200	1308	
	1983	800	1034	
	1984	1000	1220	

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NUCLEAR EXCHANGE CORPORATION

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT NO. 138

The Committee on Nuclear and Alternative Energy has released its final report to the **US** National Academy of Sciences. Entitled *Energy in Transition, 1985–2010,* the four-year study finds nuclear fission and coal to be the only economically feasible sources of energy for the US for several decades. However, in view of the environmental problems caused by burning coal, and the fact that its use in the production of synthetic fuel will be required, the report concluded that nuclear fuel should be favored over coal for the production of electricity. It is not known what part the report will play in the formulation of US energy policy.

Several countries, including **Italy, Japan, Spain** and the **USSR,** have recently announced progress in their nuclear power programs. **Sweden's** nuclear power referendum, to be held in March, is expected to show its citizens strongly in favor of nuclear power.

The optimum enrichment plant tails assay is expected to increase, as separative work prices escalate rapidly simultaneous to the decline in the price of natural uranium. A higher transaction tails assay will boost uranium requirements somewhat, partially mitigating the decrease in demand of recent years.

Beginning with this Report, selected government indexes for **Australia** and **Canada** will be included in the *Statistical Data* section.

Potential decreases in **South African** uranium production due to a drop in the cutoff grade of gold ore mined are likely to be offset as more gold-bearing areas become economically exploitable, and new tailings recovery operations come under consideration. Indeed, these occurrences could lead to a net increase in uranium production.

In **Australia**, Electrolytic Zinc (EZ) decided to join Peko-Wallsend in purchasing the government's 50 percent share of Ranger. It is likely that Ranger Export Development Company will continue to market the Ranger production associated with Peko and EZ.

US President Carter is expected to order an extension of the March 10, 1980, deadline concerning renegotiation of the US/Euratom agreement for cooperation, as set forth in the US Nuclear Non-proliferation Act of 1978. This would avoid a cutoff of US uranium exports to the Euratom nations as of that date.

The **Federal Republic of Germany** (FRG) led the near-term market activity in the US this month with an inquiry to purchase 1,000,000 pounds U_3O_8 for 1980 delivery. The inquiry is in connection with the US/FRG offset agreement. A total of about 6,000,000 pounds U_3O_8 was offered by US sellers under this inquiry.

Exchange Value decreased $0.75 to $40.00 per pound U_3O_8 this month. Utility inventory holders continue to be a significant factor in the price decline, providing most of the active price competition in the current market. Uranium producers have not been active for various reasons. **Transaction Value** decreased $0.30 to $42.00, and the **Loan Use Charge Rate** remained at 7% per annum.

This month's *Topical Essay* deals with the subject of Forward Costs used in connection with reserve estimates.

Raw Materials concludes the series on by-product uranium from phosphate.

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1/31/80

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